

THREE NEW SPECIES OF DIPTERA RELATED TO AGROMYZA PUSILLA MEIG.*

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A number of species of *Agromyza* mining the leaves of clover, bean, pea, onion and other economic crops have been confused in literature during the past years. They have frequently been discussed under the name "serpentine leaf miner," *Agromyza pusilla*. Webster and Parks (1913) record this species from 25 hosts indicating that the larvæ make linear or serpentine mines. However, *Agromyza pusilla* does not produce a serpentine mine. The larva may make a script-like trace at first but this soon becomes obscured by the formation of a small blotch mine. In Europe, according to Hering, De Meijere and others, this species makes blotch mines on the leaves of Euphorbiaceæ. Apparently several species are included in the paper by Webster and Parks.

The present discussion deals with *Agromyza pusilla* Meig., and related forms and describes three new, closely related species. They can be distinguished readily by means of color markings, structure and habits. These species are placed in the genus *Liriomyza* by European workers and are separated from the genus *Agromyza* by the yellow scutellum and the fact that the subcosta terminates in the wing margin free from vein one.

The yellow and black markings used so frequently in separating *Agromyzidæ* are apparently dependable. When these insects are boiled in caustic potash, the yellow disappears leaving transparent areas; the black markings which are heavily sclerotized areas of the body wall, remain as brown spots identical with the original black areas of the body wall.

With the aid of considerable European material, determined by Dr. Martin Hering, and a long series of specimens reared from different hosts in this country, the writer has been able to separate some of the species which have been confused with *pusilla*.

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From larvæ making serpentine mines on nasturtium (*Tropæolum*), Cruciferæ and other hosts, a new species has been reared which the writer is calling *subpusilla*. Larvæ from small blotch mines on clover, beet and other hosts have invariably yielded *Agromyza pusilla*. A small species, reared from linear mines on onion, is described as *Agromyza allia*. These and their closely related species can readily be separated by means of the following key.

KEY TO NORTH AMERICAN SPECIES OF AGROMYZA RELATED TO *pusilla* MEIG.

- Frontal orbits narrowly glossy black along eye margins; antennæ small; pleuræ and abdomen almost entirely glossy black, Illinois, food plant unknown *deceptiva* Mall.
- Frontal orbits chiefly yellow; antennæ of moderate size; pleuræ and abdomen largely yellow 1
1. Mesopleura chiefly black or dark brown, only narrowly yellow above or below 2
- Mesopleura distinctly yellow, at least a broad band of yellow along the upper edge, usually only a small dark spot below 3
2. Legs black, only knees yellow, antennæ wholly yellow, third segment darkened at the tip, palpi yellow slightly darkened at the tips, 4 orbitals, 4 rows of acrostichals, orbits broad below the eye margin. On aquatic plant, Europe, a leaf miner on *Pisum sativum*, Calif. *orbona* Meigen
- Legs largely yellow, only tibiæ and tarsi brownish, front coxæ yellow; palpi and antennæ entirely yellow, 4 orbitals, orbits narrow below the eye margin. A miner on *Equisetum*, Europe, Michigan, Kansas. *virgo* Zett.
3. Third antennal segment angulate above; last section of fifth vein three times as long as the preceding section, food plant unknown; S. D. *holti* Mall.
- Third antennal segment not angulate at apex, last section of fifth vein usually shorter 4
4. Small species, legs principally yellow 5
- Larger species; legs usually black, knees only yellow; a linear miner on grasses; Eur., Calif., Ariz. *flaveola* Fall (= *scutellata*)
5. Three pairs of orbitals; mesonotum slightly dusted; third antennal segment distinctly pubescent; a blotch miner on clover, beet and *Lactuca*; Europe, Michigan, Kansas, N. Y., Pa., Calif., Ga., Ill. *pusilla* Meig.
- Four pairs of orbitals; mesonotum shiny black, third antennal segment not distinctly pubescent 6
6. Mesonotum very lightly dusted; orbits entirely yellow, the color extending completely around the eyes and not intercepted by the black of the occiput; no bristles in front of the presuturals; anterior humeral callosities broadly and posterior humeral callosities narrowly yellow. A linear miner on *Allium cepa*; Iowa, Mich., Kans. *allia* n. sp.

- Mesonotum shiny black; orbits not entirely yellow, the color intercepted near the vertex by the black of the occiput 7
7. Veins 2 and 3 much closer together than veins 3 and 4; vein 4 straight; yellow color of orbits only slightly intercepted by the black of the occiput; both vertical bristles arising from the yellow area; posterior humeral callosities yellow; acrostichals minute or absent; a small blotch miner on lima beans, N. J. *phaseolunata* n. sp.
- Veins 2 and 3 spaced the same distance as veins 3 and 4, vein 4 distinctly curved; yellow color of orbits broadly intercepted by the black of the occiput; only the inner vertical bristle arising from the yellow area; posterior humeral callosities not yellow; acrostichals small but distinct; a linear miner on nasturtium, aster, milkweed, fern and certain Cruciferae; Ariz., Calif., Colo., Id., Kans., Mich., N. Mex., N. Y., Pa., Tex. *subpusilla* n. sp.

Agromyza subpusilla n. sp.

A small species less than 1.5 mm. long.

MALE: Front, face, cheeks, palpi, proboscis and antennae entirely yellow; scutellum in the middle, pleurae and legs largely yellow; ocellar triangle shiny black continuous with the black of the occiput; yellow of cheeks not extending completely back of eye but broadly intercepted at vertex by the black color of the occiput; only the inner vertical bristle arises from the yellow area; frontal orbits slightly darkened on the upper outer angles; third antennal segment small, rounded and distinctly white pubescent; arista brown, microscopically and sparsely pubescent; oral vibrissae distinctly stronger than accompanying setae extending along the lower margin of the cheek; setae of palpi black; four distinct orbital bristles; upper two pairs strong, lower two pairs weaker; orbital hairs minute and sparse. Mesonotum shiny black, sides broadly yellow, anterior humeral callosities yellow each with a black spot, humeral bristle arising from the edge of this spot; four pairs of dorsocentrals, the anterior two pairs shorter than the posterior two pairs; four or five rows of small but distinct acrostichals, more numerous in front of the transverse suture; presutural bristles arising from the edge of the black area of the mesonotum, a distinct but small bristle in front of the presutural bristle; sternopleura with a large triangular black spot below and a broad yellow band above, only one distinct sternopleural bristle, a minute seta in front of this; mesopleura with a small spot on the lower anterior edge, a small spot on the upper edge of the mesopleura, anterior supraalar bristle arising near this spot, mesopleura with one distinct bristle and three smaller, accompanying bristles; hypopleura with a large dark spot. Abdomen dark brown, incisures narrowly yellow; male genitalia shiny brown, yellow below. Wings hyaline; third and fourth veins diverging distinctly, fourth vein distinctly curved, veins 2 and 3 spaced the same as veins 3 and 4, last section of fifth vein about four times the length of the penultimate section, anterior cross vein slightly beyond the middle of the discal cell, posterior cross vein about twice the length of the anterior cross vein. Legs chiefly pale

in color, femora yellow, tibiæ and tarsi brown, no distinct preapical bristles. Halteres yellow.

FEMALE: Similar to the male; incisures of the abdomen conspicuously but narrowly yellow, last incisure more broadly yellow, genitalia shiny black.

Holotype ♂ Manhattan, Kans., Oct. 14, 1933. Collected by C. W. Sabrosky. 67 paratypes from California, Colorado, Michigan, Kansas, Texas, Arizona, New Mexico, Idaho, Pennsylvania and New York. The larvæ produce linear mines on the leaves of the following plants: Cruciferæ, Eupatorium, Asclepias, Aster, Nasturtium (*Tropæolum*), Plantago and fern. The record for nasturtium, Frost (1924) and Needham & Frost (1928) is *Agromyza subpusilla*.

***Agromyza phaseolunata* n. sp.**

A small species less than 1.5 mm.

MALE: Front, face, cheeks, palpi, proboscis, antennæ, scutellum in the middle, pleuræ, legs largely and halteres yellow; ocellar triangle shiny black continuous with the black of the occiput; yellow of cheeks not extending entirely back of the eye but intercepted at the vertex by the black color of the occiput, both vertical bristles arising from the yellow area; frontal orbits entirely yellow; third antennal segment small rounded, sparsely pubescent; arista brown; orbital bristles moderately strong accompanied by a few weak bristles extending along the lower margin of the cheek; setæ of palpi black, those of proboscis yellow; four distinct pairs of orbital bristles, upper pairs slightly stronger, orbital hairs minute and sparse. Mesonotum shiny black, sides broadly yellow, anterior humeral callosities broadly and posterior callosities narrowly yellow, anterior callosities each with a dark spot, the humeral bristle arises from the yellow area near this spot, four pairs of dorsocentral bristles, the anterior pair distinctly weaker than the posterior pairs; acrostichals minute or absent; presutural bristle arising from the edge of the black color of the mesonotum, a minute seta in front of the presutural bristle; sternopleura with a large triangular dark spot below and a broad yellow band across the top, only one distinct sternopleural bristle, a minute seta in front of the sternopleural bristle; mesopleura with a small spot on the lower anterior angle, similar to that of *subpusilla*; a small spot on the upper anterior angle of the mesopleura; anterior supraalar arising near this spot; mesopleura with one strong bristle and three small accompanying setæ; a small irregular spot on the pteropleura at the base of the wing; hypopleura with a large dark spot. Abdomen shiny brown above; incisures narrowly yellow, the last incisure broadly yellow; sides and ventral surface of the abdomen yellow; ♂ genitalia shiny brown, yellow in center above. Wings hyaline, 3rd and 4th veins not diverging conspicuously at their tips; veins 2 and 3 approximated, veins 3 and 4 more widely separated; anterior cross vein slightly beyond the middle of the discal cell, posterior cross vein about one and a half times as long as

the anterior cross vein. Legs chiefly pale in color, femora yellow, tibiæ and tarsi pale brown. Halteres yellow.

Holotype ♂ reared from small blotch mine on lima bean collected at Bridgeton, N. J., August 24, 1942, by B. B. Pepper. Although only four specimens were available to describe this species it has well defined characteristics, especially the lack of distinct acrostichals and the approximation of veins 2 and 3. This species apparently caused considerable injury during 1942. The infestation covered 2000 acres and a large percentage of the leaves were infested. It is distinct from three other agromyzids known to attack beans, namely, *Agromyza destructor* Mall. of the Philippine Islands, *Agromyza inæqualis* Mall. of the West Indies and *Agromyza (Melanagromyza) phaseoli* Coq. from Australia and the Philippine Islands. All these species have the scutellum and the halteres dark brown or black in contrast to the yellow halteres and scutellum of *Agromyza phaseolunata*.

***Agromyza allia* n. sp.**

A minute species approximately 1 mm. long.

MALE: Front, face, cheeks, antennæ, palpi, proboscis, halteres, scutellum in center, legs and pleuræ chiefly yellow; front as wide as either eye, sides nearly parallel, four pairs of orbitals, the lower pair often weak; orbital hairs minute and sparse; 3rd antennal segment small, rounded at tip; arista brown, minutely and sparsely pubescent; hairs of palpi black, those of proboscis yellow; oral vibrissæ stronger than accompanying setæ along the lower margin of cheek; cheeks about one half eye height, slightly narrower in front than behind; yellow of cheeks continuing around eyes and joining yellow of frontal orbits, orbits in other words completely yellow; ocellar triangle shiny black, separated from the occiput by a narrow yellow line. Mesonotum cinereous black, sides broadly yellow; presutural bristle arising from yellow area of mesonotum; pleuræ chiefly yellow, sternopleura with a large triangular black spot below and a yellow band above, one strong sternopleural bristle with a minute seta anterior to it; mesopleura almost entirely yellow, a minute spot on upper anterior angle, one strong mesopleural bristle with 4 small accompanying bristles, pteropleura largely black; anterior and posterior humeral callosities yellow; scutellum yellow, darkened on the sides, especially at the base, four pairs of dorsocentrals, anterior pair weaker; acrostichals minute distinctly shorter than anterior pair of dorsocentrals; presutural and anterior humeral bristles arising from the yellow area of the mesonotum; spot on the anterior humeral callosity small and indistinct. Abdomen largely yellow, underside, 1st segment and incisures broadly yellow, only the basal portions of the upper sides of the segments brown, the brown spot on the second segment divided by a narrow central yellow line; ♂ genitalia sub-

shiny brown. Legs chiefly yellow, tibiae and tarsi only weakly infuscated, no evidence of preapical bristles. Wings hyaline, 3rd and 4th veins nearly parallel at tips, apical section of 5th vein about three times the length of the preapical section, anterior cross vein at about the middle of the discal cell, posterior cross vein about one and a half times the length of the anterior cross vein. Calypteres and fringe and halteres yellow.

FEMALE: Similar to male but ovipositer shiny black.

Holotype ♂ Manhattan, Kans., June 9, 1934, C. W. Sabrosky. 27 paratypes from Iowa, Kansas, Michigan and Missouri. This species has been reared by H. M. Harris (1933) Ames, Iowa, from linear mines on onion.

This species can readily be separated from the European *Dizygomyza cepæ* Hering which also makes short linear mines on onion. The scutellum of this species is entirely black.

Agromyza pusilla Meigen.

Front, face, palpi, proboscis, antennæ, pleuræ and legs chiefly, scutellum in center, sides of abdomen and halteres yellow; three pairs of fronto orbitals, the anterior pair weaker, orbital hairs minute and sparse; 3rd antennal segment rounded with microscopic but conspicuous white pubescence; arista brown; hairs of palpi black; those of proboscis yellow; oral vibrissæ stronger than other setæ along the lower edge of the cheeks; yellow of cheeks not continuous back of eye but intercepted near the vertex by the black of the occiput; both vertical bristles arising from the yellow area; ocellar triangle shiny black and continuous with the black area of the occiput. Mesonotum black, slightly dusted; sides broadly yellow; presutural bristles arising from the black area of the mesonotum; pleuræ largely yellow, sternopleura with a large triangular black spot below and a yellow band above, one strong sternopleural bristle and a minute seta in front of this; mesopleura with a minute black spot on upper anterior angle, one mesopleural bristle and three minute accompanying setæ; pteropleura chiefly black; anterior and posterior humeral callosities yellow; anterior humeral bristle arising from the edge of the dark color of the mesonotum; scutellum yellow, darkened on sides especially at the base; presutural bristle distinct, no bristle in front of the presutural; four pairs of dorsocentral bristles, the anterior pair distinctly weaker; four

rows of conspicuous acrostichals before the transverse suture, as strong as anterior pair of dorsocentrals. Abdomen shiny brown above, incisures narrowly yellow, last incisure broadly yellow, sides and ventral surface of abdomen yellow, ♂ genitalia shiny black. Legs chiefly yellow, tibiæ and tarsi pale brown. Wings hyaline, veins 2, 3 and 4 equally spaced, anterior cross vein distinctly beyond the middle of the discal cell, posterior cross vein one and a half times as long as the anterior cross vein, 4th vein only slightly curved, cross veins not parallel. Halteres yellow.

The writer has before him 38 specimens of this species from California, Georgia, Missouri, Illinois, New York and Pennsylvania. They were compared with one specimen of *Agromyza pusilla* Meig from Prussia which was identified by De Meijere. They were also compared with a series of specimens from Dallas, Texas, in the National Museum and determined by J. R. Malloch.

The larva of *Agromyza pusilla* makes a small blotch mine on the leaves of clover, beet, *Asclepias*, and *Lactuca*. Hering (1927) states that in Europe this species mines the leaves of Euphorbiaceæ.

Agromyza orbona Meigen.

Malloch (1913) placed this species as a synonym of *pusilla* Meig. European workers, especially De Meijere, Hendel and Hering recognize *orbona* as a distinct species. It is said to mine the leaves of an aquatic plant. This species has repeatedly been reared from the leaves of peas from California and has been frequently confused with *flaveola* Fall. *Orbona* differs, however, in having the pleuræ chiefly black.

A note on the genitalia of the Agromyzidæ. The agromyzid genitalia is typical of the higher Diptera but even more highly specialized than that of the muscids. The ninth tergite is large, rounded and the most conspicuous part of the genitalia. It is heavily sclerotized, bears conspicuous setæ and sometimes accessory hairs on the outer surface. The present status of the homologies of structures of genitalia is too poor to attempt to label them. The appendages of the ninth tergite bear the most specific characters. The number and position of the teeth on these are most valuable in separating the different species. *A. pusilla* and *A. phaseolunata* have but a single tooth at the end of this

appendage. *A. pusilla* has in addition a strong short spine on the inner surface of the ninth tergite. In *A. subpusilla* and *A. allia* there are two teeth on the appendage of the ninth tergite. The smaller tooth in *A. subpusilla* is situated near the middle of the appendage, in *A. allia* the two teeth are approximated at the tip of the appendage.

The ejaculatory apparatus is a conspicuous feature of the male sexual organs. It occurs on the left side of the body in the region of the 5th and 6th abdominal segments. The ejaculatory apodeme is a highly sclerotized, funnel-shaped structure which pierces the transparent, bulbous ejaculatory syringe. A short duct leads from the ejaculatory syringe to the base of the ædeagus.

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PLATE XI

- Figure 1. Mine of *Agromyza pusilla* Meig. on *Lactuca scariola*.
- Figure 2. Mine of *Agromyza pusilla* Meig. on clover.
- Figure 3. Mine of *Agromyza subpusilla* Frost on nasturtium (*Tropaeolum*).
- Figure 4. Mines of *Agromyza phaseolunata* Frost on lima bean.
- Figure 5. Mesopleuron and sternopleuron of *Agromyza pusilla* Meig.
- Figure 6. Mesopleuron and sternopleuron of *Agromyza subpusilla* Frost.
- Figure 7. Mesopleuron and sternopleuron of *Agromyza orbona* Meig.

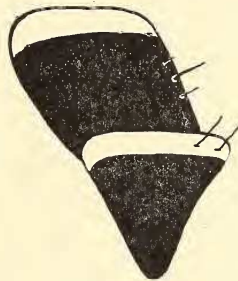
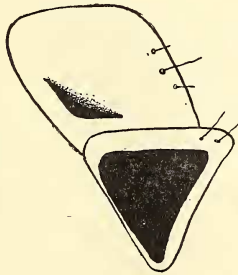
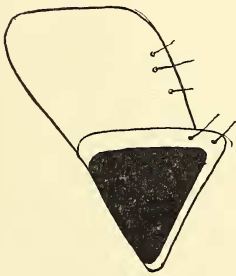
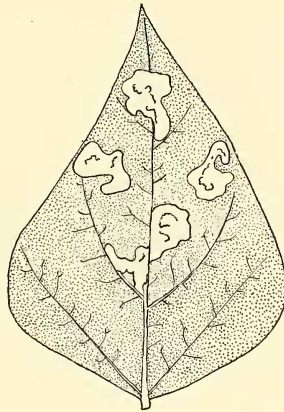
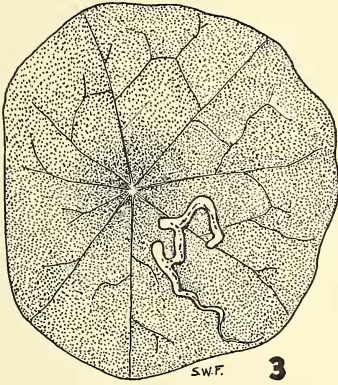
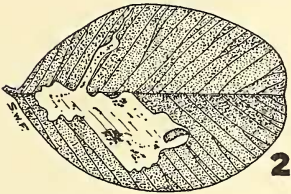
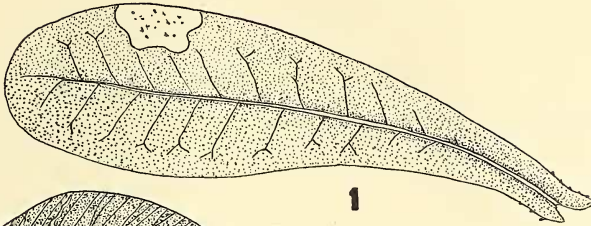


PLATE XII

- Figure 1. ♂ Genitalia of *Agromyza pusilla* Meig.
Figure 2. ♂ Genitalia of *Agromyza phascolonata* Frost.
Figure 3. ♂ Genitalia of *Agromyza subpusilla* Frost.
Figure 4. ♂ Genitalia of *Agromyza allia* Frost.

